

Ghost Forest of Driftwood Beach

(3E1, 4L1, 5L1, 6E5, 7L4, ENV2, ENV4, BIO5)

Time

45 min to observe phenomenon and investigate on site
45 min to research questions and conduct an investigation

GSES Standard (# and text) Character Count: 1000

NOTE: The Ghost Forest phenomenon at Driftwood Beach, Jekyll Island, GA will be used for multiple grade levels, based on the following science standards:

S3E1. Obtain, evaluate, and communicate information about the physical attributes of rocks and soils.

c. Make observations of the local environment to construct an explanation of how water and/or wind have made changes to soil and/or rocks over time. (Clarification statement: Examples could include ripples in dirt on a playground and a hole formed under gutters.)

S4L1. Obtain, evaluate, and communicate information about the roles of organisms and the flow of energy within an ecosystem.

c. Design a scenario to demonstrate the effect of a change on an ecosystem. (Clarification statement: Include living and non-living factors in the scenario.)

S5L1. Obtain, evaluate, and communicate information to group organisms using scientific classification procedures.

b. Develop a model that illustrates how plants are sorted into groups (seed producers, non-seed producers) using data from multiple sources.

S5E1. Obtain, evaluate, and communicate information to identify surface features on the Earth caused by constructive and/or destructive processes.

- a. Construct an argument supported by scientific evidence to identify surface features (examples could include deltas, sand dunes, mountains, volcanoes) as being caused by constructive and/or destructive processes (examples could include deposition, weathering, erosion, and impact of organisms).
- b. Develop simple interactive models to collect data that illustrate how changes in surface features are/were caused by constructive and/or destructive processes.
- c. Ask questions to obtain information on how technology is used to limit and/or predict the impact of constructive and destructive processes. (Clarification statement: Examples could include seismological studies, flood forecasting (GIS maps), engineering/construction methods and materials, and infrared /satellite images.)

S6E5. Obtain, evaluate, and communicate information to show how Earth's surface is formed.

- d. Ask questions to identify types of weathering, agents of erosion and transportation, and environments of deposition. (Clarification statement: Environments of deposition include deltas, barrier islands, beaches, marshes, and rivers.)
- e. Develop a model to demonstrate how natural processes (weathering, erosion, and deposition) and human activity change rocks and the surface of the Earth.
- h. Plan and carry out an investigation to provide evidence that soil is composed of layers of weathered rocks and decomposed organic material.

S7L4. Obtain, evaluate, and communicate information to examine the interdependence of organisms with one another and their environments.

a. Construct an explanation for the patterns of interactions observed in different ecosystems in terms of the relationships among and between organisms and abiotic components of the ecosystem. ---->

Phenomenon



c. Analyze and interpret data to provide evidence for how resource availability, disease, climate, and human activity affect individual organisms, populations, communities, and ecosystems.

d. Ask questions to gather and synthesize information from multiple sources to differentiate between Earth's major terrestrial biomes (i.e., tropical rainforest, savanna, temperate forest, desert, grassland, taiga, and tundra) and aquatic ecosystems (i.e., freshwater, estuaries, and marine). (Clarification statement: Emphasis is on the factors that influence patterns across biomes such as the climate, availability of food and water, and location.)

SENV2. Obtain, evaluate, and communicate information to construct explanations of stability and change in Earth's ecosystems.

- b. Analyze and interpret data to determine how changes in atmospheric chemistry (carbon dioxide and methane) impact the greenhouse effect.
- c. Construct an argument to predict changes in biomass, biodiversity, and complexity within ecosystems, in terms of ecological succession.
- d. Construct an argument to support a claim about the value of biodiversity in ecosystem resilience including keystone, invasive, native, endemic, indicator, and endangered species.

SENV4. Obtain, evaluate, and communicate information to analyze human impact on natural resources.

- a. Construct and revise a claim based on evidence on the effects of human activities on natural resources.
- b. Design, evaluate, and refine solutions to reduce human impact on the environment including, but not limited to, smog, ozone depletion, urbanization, ocean acidification.

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SBI05. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment.

- a. Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity; populations in ecosystems.
- c. Construct an argument to predict the impact of environmental change on stability of an ecosystem
- d. Design a solution to reduce the impact of a human activity on the environment. (Clarification statement: Human activities may include chemical use, natural resources consumption, introduction of non-native species, greenhouse gas production)
- e. Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).

Lesson Overview Character Count: 1000

Students will observe the phenomenon of the Ghost Forest at Driftwood Beach on Jekyll Island, ask questions, and propose an initial explanation for what happened to the trees and how. Then they will conduct research based on their questions; undertake investigations related to grade level and standard (see ideas below); hypothesize the type of disturbance(s) that affected Driftwood Beach in the past; consider what stage of succession is currently observable; and predict what the Beach's future may be. Later, they will apply the same analysis to a local setting, such as the schoolyard, and conduct a parallel investigation.

Engage Character Count: 900

Walk to Driftwood Beach on the northeast end of Jekyll Island and observe the Ghost Forest phenomenon. Prompt students to write about what they observe ("I notice..."); what they are curious about ("I wonder..."), and what they propose as a tentative explanation. Or look at the photos above, which include a picnic area amid living trees on Driftwood Beach in the 1960s; no visible picnic tables and dying or dead trees at the turn of the century; and dead, bleached trees on present-day Driftwood Beach.

Elicit Questions Character Count: 900

Students will ask questions about the phenomenon they observed. It can be anticipated that these questions might include: what kind of trees are these? why did they die? how old were they when they died - and how long has it been since they died? why are there no living trees of a certain species on the beach? are the trees in the nearby forest of the same or different species? is the shape of Jekyll Island changing? if so, why? what will happen to this beach in the future?

Allow students to research questions they are curious about in teams with other students who are similarly interested. The following curated list of articles may be useful. Using the [Jigsaw Classroom protocol](#), students may read and discuss an article in a research team, and then return to a home team consisting of one expert per article, to share information they learned.

Trees of Driftwood Beach and Maritime / Ghost Forests

- Ai Reveals Vast Ghost Forests Along US Coast
- <https://www.science.org/content/article/ai-reveals-vast-ghost-forests-along-u-s-coast>

- Last Standing Tree at Driftwood Beach falls during Tropical Storm
- https://thebrunswicknews.com/news/local_news/iconic-tree-at-ever-changing-driftwood-beach-falls/article_4a3ad630-559c-11ef-99b6-07ef19f2229f.html

- Determining Tree Age Ranger Rick
- <https://m.youtube.com/watch?v=RqezxrlquKM&pp=0gcJCdgAo7VqN5tD>

- Maritime Forest Phases
- <https://ssl.org/protected-properties-2/cannons-point-preserve/research/maritime-forest-restoration/>

- The Maritime Forest
- <https://gacoast.uga.edu/wp-content/uploads/2016/05/MaritimeForest.pdf>

- Maritime Oak Forest
- <https://gacoast.uga.edu/about/georgia-coast/maritime-forest/>
- 500 Year Old Trees on Jekyll
- <https://www.thetravel.com/what-makes-driftwood-beach-so-unique/>
- History of Driftwood Beach
- <https://www.parchedaroundtheworld.com/articles/driftwood-beach-jekyll-island-georgia/>
- Driftwood Beach: Magical and Surreal
- <https://www.forbes.com/sites/garystoller/2023/05/23/driftwood-beach-a-magical-surreal-georgia-shoreline/>

Sea Level Rise, Salt Water Intrusion, and Salt Marsh Succession

- Salt Marsh Succession article
- <https://www.field-studies-council.org/resources/16-18-biology/succession/saltmarsh/>

Let's Go Enviro! Salt Marsh Succession video

- <https://gpb.pbslearningmedia.org/collection/lets-go-enviro/>
- and <https://gpb.pbslearningmedia.org/resource/introduction-changes-earths-ecosystems/unit-2-stability-and-change-in-ecosystems-lets-go-enviro/>
- Ghost Forests benefit Birds as Marshland
- <https://www.audubon.org/news/ghost-forests-could-provide-respite-marsh-birds-coastal-habitat-disappears#:~:text=Ghost%20forests%20are%20markers%20of,dead%20forests%20represent%20an%20opportunity.>

Erosion and Deposition on Georgia Barrier Islands

- Driftwood Beach
- <https://www.atlasobscura.com/places/driftwood-beach>
- Driftwood Beach Draws Critics and Admirers
- <https://www.jacksonville.com/story/news/2016/11/22/driftwood-beach-draws-critics-admirers/15732752007/>
- Georgia's Changing Beaches
- <https://coastalgadnr.org/Coastlines/April2024/Beaches>
- Shifting Sands and Erosion in Brunswick Area
- https://thebrunswicknews.com/news/local_news/shifting-sands-erosion-concerning-as-tourism-season-approaches/article_7f8ff5cd-749c-5555-ab8f-9bb1ea5825ec.html
- Geology of the Georgia Coast
- <https://www.georgiaencyclopedia.org/articles/science-medicine/geology-of-the-georgia-coast/>
- Our Precious and Precarious Coast
- <https://onehundredmiles.org/sea-level-rise/>

Explore **Character Count: 900**

Support student-led, curiosity-driven **research** on questions about the phenomenon.

Facilitate student-led **investigations** about the processes occurring on Driftwood Beach, related to grade and standards. Consider:

1. Identify the trees. Compare the species' known salt tolerances to local conditions.
 - a. Identifying petrified wood without leaves, twigs, buds, or bark is difficult. Try these approaches:
 - i. Context clues: What living trees can be identified nearby? Are they similar to dead beach trees?
 - ii. Location clues: What tree species are in the area according to [SEEK](#) or another app that geo-locates you?
 - iii. Expert clues: Consult a forester, naturalist, or gardener who can help identify trees in person or online.
 - iv. Tech clues: Download the [Rock'd app](#) and click on maps to identify substrata and geological info
 - v. DNA evidence: Collect a sample from a dead tree and send it for [DNA testing](#) using [Lifescanner](#) (\$43)
2. Measure [soil salinity](#) in the vicinity of the dead trees on Driftwood Beach. Compare to known tolerances of tree species in the area (both living and dead).
 - a. Soil Salinization Lab for high school <https://teachingapscience.com/soil-salinization-lab/>
 - b. Salinity tolerances of tree and shrubs - USDA https://efotg.sc.egov.usda.gov/references/public/ND/Salinity_Tolerances_of_Trees_and_Shrubs.pdf
 - c. Relative Salt Tolerance of Selected Plants <https://www.sewrpc.org/SEWRPCFiles/Environment/ChlorideImpactStudy/TR-62-AppendixCPreliminaryDraft.PDF>

- d. Georgia's Saltwater-tolerant Native Trees
<https://extension.uga.edu/publications/detail.html?number=B1477&title=selecting-salt-tolerant-native-trees-for-the-georgia-coast#:~:text=In%20a%20sandy%20loam%20soil,4.5%20dS%2Fm%20or%20less>
3. Consult tide maps to determine whether / when / how often Driftwood Beach is completely inundated
 - a. Observe the high tide line and determine how much, if any, distance between high tide and inland vegetation
 - b. Observe beach at high tide and low tide to confirm size of beach (subtract one hour to convert tide charts from Jekyll Wharf to Driftwood Beach location) <https://jekyllrealty.com/things-to-do/jekyll-island-tide-chart/>
 - c. Consider this article about how Ghost Forests Grow as Sea Levels Rise
<https://www.livescience.com/planet-earth/climate-change/ghost-forests-are-growing-as-sea-levels-rise>
 - d. Search for the concrete picnic tables that are/were located on Driftwood Beach and consider what may have happened to them
4. Consider the impact of sea level rise on trees at Jekyll Island and Driftwood Beach
 - a. Observe these models to see how predicted 1 ft and 7 ft sea level rise would affect Jekyll Island land mass
<https://storymaps.arcgis.com/stories/26120f3017e243ec88807d560c4c0398>
5. Look at time lapse maps to find locations where erosion and accretion are taking place on Jekyll Island
 - a. Place a finger or marker on edge of beach at south and north tips of Island and watch time-lapse of satellite maps to observe changes
https://earth.google.com/web/search/Jekyll+Island,+GA/@31.0352656,-81.44495168,1.61039025a,7543.75974605d,35y,0h,0t,0r/data=CjsiJgokCWDFTFVQHiDAEaRdfH0ugSHAGas9Hq-LcFLAISiXepn71VLAOg0IAREAAAAAADgPyABQgIIAToDCgFwQgIIAEoNCP_wEQAA
6. Determine whether / how Jekyll Island has been impacted by hurricanes, including land mass and tree species.
 - a. [Shifting Sands, Changing Tides](#)
 - b. [Hurricanes of Glynn County](#)
 - c. [Hurricane Irma Damages Jekyll](#)
7. Compare observed conditions to archaeology records, old postcards and other historic information about Jekyll Island
 - a. [Digging Up the Past](#) - read about archaeological studies on Jekyll Island
 - b. Compare postcard from 1950s to photo from 2020s, above
 - c. [Wood Petrification Study](#) - model how wood becomes petrified to learn more about forces at work on Jekyll Island

Engineer Character Count: 900

Design, build and test a sand sieve and/or trawl to see how well they capture microplastics.

Explain Character Count: 900

After completing research and investigations, prompt students to return to their initial explanations and revise them to include new understandings, and more completely explain the causes, mechanisms, and future predictions about biotic and abiotic changes at Driftwood Beach.

[Create a labeled model](#) (or a working model) that illustrates a claim and evidence about the causes and mechanisms of changes on Jekyll Island at Driftwood Beach, based on the "Jekyll on the Move" lesson from Jeremy Peacock.

https://docs.google.com/document/d/1uY4OKyC6GJGN5v_i46oVIHezfBt_twZf4NW6VPYbOA8/edit?tab=t.0

Environmental Stewardship / PBL Character Count: 900

Students will propose a solution that will minimize the role of human impact on altering the changes to Jekyll and other barrier islands. (Alternative: students may propose a solution for a factor limiting ecosystem health of the schoolyard).

Extend Character Count: 900

Conduct research and a parallel investigation regarding a native tree species growing in or near the schoolyard (or a species that is conspicuously absent, if no native trees are found on school grounds). Consider what disturbances, such as development, landscaping, grounds maintenance, or construction of a drainage system and retention ponds, may have altered the natural ecosystem in this area.

Evaluate Character Count: 900

Assessment of student understanding and performance tasks will vary with the grade level and lesson component investigated under the overarching phenomenon of change on Driftwood Beach (severe weather and storm surges, wave action, sea level rise due to thermal expansion or melting of land ice, saltwater intrusion, erosion and accretion, etc.).

Re-Teach Character Count: 900

Conduct some of the suggested research related to other grade levels and standards, to create a more complete understanding of the changes that have occurred and are still occurring on Jekyll Island.

How this Lesson incorporates “Gather / Reason / Explain / Act / Teach” or “Obtain / Evaluate / Communicate” framework

Check relevant sections and add a line that describes specific, related lesson activities on the right. Character Count: 144

Gather / Obtain includes any of the following:

- Obtaining Information
- Asking Questions/Defining Problems
- Planning & Carrying Out Investigations
- Using Models to Gather Data
- Using Mathematics / Computational Thinking

Reason / Evaluate includes any of the following:

- Evaluating Information
- Analyzing Data
- Using Mathematics / Computational Thinking
- Developing Evidence
- Constructing Explanations / Solving Problems
- Using Models to Predict & Develop Evidence

Explain / Communicate includes any of the following:

- Communicating Information
- Arguing from Evidence (written & oral)
- Using Models to Explain or Communicate

Act

- Student-Directed Stewardship Project or Civic Action

Teach

- Presentation of Project to Stakeholders / Reflection

How this Learning Experience Integrates 3-D Science The checked elements are integrated in this lesson:**Science and Engineering Practice**

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Mathematical and Computational Thinking
- Constructing Explanations and Designing Solutions
- Engaging in Argumentation from Evidence
- Obtaining, Evaluating and Communicating Information

Students will gather or obtain data and information by . . .

Answer Here or N/A

Students will reason and evaluate data or other info by . . .

Answer Here or N/A

Students will explain and communicate by . . .

Answer Here or N/A

Answer Here or N/A

Answer Here or N/A

Students will solve a real-world problem by . . .

.

Answer Here or N/A

Students will share their findings and reflect by . . .

Answer Here or N/A

Crosscutting Concepts

- Patterns
- Cause and Effect
- Scale, Proportion and Quantity
- Systems and System Models
- Energy and Matter
- Structure and Function
- Stability and Change

Core Ideas

Physical Science

- Matter and Its Interactions
- Motion and Stability / Forces and Interactions
- Energy
- Waves and their Applications in Info Transfer

Life Science

- Structure and Processes
- Ecosystem Interactions, Energy and Dynamics
- Heredity, Inheritance and Variations
- Biological Evolution, Unity and Diversity

Earth and Space Science

- Earth's Place in the Universe
- Earth's Systems
- Earth and Human Activity

Engineering

- Engineering Design Process
- Links among Engineering, Technology, Science and Society

How this Learning Experience integrates STEM: **Character Count: 900**

Depending on grade level for which the lesson is done, students may conduct labs and investigations that incorporate math and technology.

What parts of this lesson are suited for Outdoor Learning and why?: **Character Count: 900**

Observation of phenomenon in person, for those who are on Jekyll Island; schoolyard investigation for those who are not.

Is there a project or series of which this Lesson is a part?

CoOL Schoolyards lesson collection; CREST Jekyll Island Summer Institute

Is another version of this Lesson available?

Choose yes or no.

No

Lesson Name: **Character Count: 144**